

[Table 1]
Results of thermal conductivity measurement

Sample No.	Composition	Thermal conductivity [W/(m·K)]	High thermal conductivity
1	Pure Ag	320	○
2	Ag-0.005at% Bi Alloy	319	○
3	Ag-0.2at% Bi Alloy	296	○
4	Ag-0.4at% Bi Alloy	271	○
5	Ag-0.6at% Bi Alloy	247	×
6	Ag-0.005at% Sb Alloy	319	○
7	Ag-0.2at% Sb Alloy	292	○
8	Ag-0.4at% Sb Alloy	264	○
9	Ag-0.6at% Sb Alloy	236	×
10	Ag-0.2at% Bi-0.01at% Nd Alloy	296	○
11	Ag-0.2at% Bi-0.1at% Nd Alloy	294	○
12	Ag-0.2at% Bi-0.5at% Nd Alloy	287	○
13	Ag-0.2at% Bi-2at% Nd Alloy	260	○
14	Ag-0.2at% Bi-3at% Nd Alloy	242	×
15	Ag-0.2at% Bi-0.01at% Y Alloy	296	○
16	Ag-0.2at% Bi-0.1at% Y Alloy	294	○
17	Ag-0.2at% Bi-0.5at% Y Alloy	288	○
18	Ag-0.2at% Bi-2at% Y Alloy	262	○
19	Ag-0.2at% Bi-3at% Y Alloy	245	×
20	Ag-0.2at% Sb-0.01at% Nd Alloy	292	○
21	Ag-0.2at% Sb-0.1at% Nd Alloy	290	○
22	Ag-0.2at% Sb-0.5at% Nd Alloy	283	○
23	Ag-0.2at% Sb-2at% Nd Alloy	256	○
24	Ag-0.2at% Sb-3at% Nd Alloy	238	×
25	Ag-0.2at% Sb-0.01at% Y Alloy	292	○
26	Ag-0.2at% Sb-0.1at% Y Alloy	290	○
27	Ag-0.2at% Sb-0.5at% Y Alloy	284	○
28	Ag-0.2at% Sb-2at% Y Alloy	258	○
29	Ag-0.2at% Sb-3at% Y Alloy	241	×

[Table 2]

Results of thermal conductivity measurement

Sample No.	Composition	Thermal conductivity [W/(m·K)]	High thermal conductivity
1	Pure Ag	320	○
30	Ag-0.2at% Bi-0.01at% Cu Alloy	296	○
31	Ag-0.2at% Bi-0.1at% Cu Alloy	295	○
32	Ag-0.2at% Bi-0.5at% Cu Alloy	290	○
33	Ag-0.2at% Bi-2at% Cu Alloy	260	○
34	Ag-0.2at% Bi-3at% Cu Alloy	248	×
35	Ag-0.2at% Bi-0.01at% Au Alloy	296	○
36	Ag-0.2at% Bi-0.1at% Au Alloy	295	○
37	Ag-0.2at% Bi-0.5at% Au Alloy	290	○
38	Ag-0.2at% Bi-2at% Au Alloy	262	○
39	Ag-0.2at% Bi-3at% Au Alloy	251	×
40	Ag-0.2at% Sb-0.01at% Cu Alloy	292	○
41	Ag-0.2at% Sb-0.1at% Cu Alloy	291	○
42	Ag-0.2at% Sb-0.5at% Cu Alloy	286	○
43	Ag-0.2at% Sb-2at% Cu Alloy	256	○
44	Ag-0.2at% Sb-3at% Cu Alloy	244	×
45	Ag-0.2at% Sb-0.01at% Au Alloy	292	○
46	Ag-0.2at% Sb-0.1at% Au Alloy	291	○
47	Ag-0.2at% Sb-0.5at% Au Alloy	286	○
48	Ag-0.2at% Sb-2at% Au Alloy	258	○
49	Ag-0.2at% Sb-3at% Au Alloy	247	×
50	Ag-0.2at% Bi-0.5at% Nd-0.5at% Cu Alloy	281	○
51	Ag-0.2at% Bi-0.5at% Nd-0.5at% Au Alloy	281	○
52	Ag-0.2at% Bi-0.5at% Y-0.5at% Cu Alloy	282	○
53	Ag-0.2at% Bi-0.5at% Y-0.5at% Au Alloy	282	○
54	Ag-0.2at% Sb-0.5at% Nd-0.5at% Cu Alloy	277	○
55	Ag-0.2at% Sb-0.5at% Nd-0.5at% Au Alloy	277	○
56	Ag-0.2at% Sb-0.5at% Y-0.5at% Cu Alloy	278	○
57	Ag-0.2at% Sb-0.5at% Y-0.5at% Au Alloy	278	○
58	Ag-0.2at% Si Alloy	265	○
59	Ag-0.2at% Sn Alloy	248	×

[Table 3]
Results of reflectance measurement

Sample No.	Composition	Reflectance relative to Pure Ag [%]		High reflectance
		Wavelength 405nm	Wavelength 650nm	
1	Pure Ag	90.8	92.5	○
2	Ag-0.005at% Bi Alloy	90.7	92.5	○
3	Ag-0.2at% Bi Alloy	86.2	90.8	○
4	Ag-0.4at% Bi Alloy	81.6	89.1	○
5	Ag-0.6at% Bi Alloy	77.0	87.4	×
6	Ag-0.005at% Sb Alloy	90.7	92.5	○
7	Ag-0.2at% Sb Alloy	86.1	90.7	○
8	Ag-0.4at% Sb Alloy	81.4	88.9	○
9	Ag-0.6at% Sb Alloy	76.7	87.1	×
10	Ag-0.2at% Bi-0.01at% Nd Alloy	86.2	90.8	○
11	Ag-0.2at% Bi-0.1at% Nd Alloy	85.9	90.7	○
12	Ag-0.2at% Bi-0.5at% Nd Alloy	84.8	90.3	○
13	Ag-0.2at% Bi-2at% Nd Alloy	80.7	88.6	○
14	Ag-0.2at% Bi-3at% Nd Alloy	78.0	87.5	×
15	Ag-0.2at% Bi-0.01at% Y Alloy	86.2	90.8	○
16	Ag-0.2at% Bi-0.1at% Y Alloy	85.9	90.7	○
17	Ag-0.2at% Bi-0.5at% Y Alloy	84.7	90.2	○
18	Ag-0.2at% Bi-2at% Y Alloy	80.3	88.4	○
19	Ag-0.2at% Bi-3at% Y Alloy	77.4	87.2	×
20	Ag-0.2at% Sb-0.01at% Nd Alloy	86.1	90.7	○
21	Ag-0.2at% Sb-0.1at% Nd Alloy	85.8	90.6	○
22	Ag-0.2at% Sb-0.5at% Nd Alloy	84.7	90.2	○
23	Ag-0.2at% Sb-2at% Nd Alloy	80.6	88.5	○
24	Ag-0.2at% Sb-3at% Nd Alloy	77.9	87.4	×
25	Ag-0.2at% Sb-0.01at% Y Alloy	86.1	90.7	○
26	Ag-0.2at% Sb-0.1at% Y Alloy	85.8	90.6	○
27	Ag-0.2at% Sb-0.5at% Y Alloy	84.6	90.1	○
28	Ag-0.2at% Sb-2at% Y Alloy	80.2	88.3	○
29	Ag-0.2at% Sb-3at% Y Alloy	77.3	87.1	×

[Table 4]
Results of reflectance measurement

Sample No.	Composition	Reflectance relative to Pure Ag [%]		High reflectance
		Wavelength 405nm	Wavelength 650nm	
1	Pure Ag	90.8	92.5	○
30	Ag-0.2at% Bi-0.01at% Cu Alloy	86.2	90.8	○
31	Ag-0.2at% Bi-0.1at% Cu Alloy	86.0	90.7	○
32	Ag-0.2at% Bi-0.5at% Cu Alloy	85.3	90.4	○
33	Ag-0.2at% Bi-2at% Cu Alloy	81.0	88.3	○
34	Ag-0.2at% Bi-4at% Cu Alloy	79.3	87.5	✗
35	Ag-0.2at% Bi-0.01at% Au Alloy	86.2	90.8	○
36	Ag-0.2at% Bi-0.1at% Au Alloy	86.0	90.7	○
37	Ag-0.2at% Bi-0.5at% Au Alloy	85.4	90.4	○
38	Ag-0.2at% Bi-3at% Au Alloy	81.5	88.5	○
39	Ag-0.2at% Bi-4at% Au Alloy	79.9	87.7	✗
40	Ag-0.2at% Sb-0.01at% Cu Alloy	86.1	90.7	○
41	Ag-0.2at% Sb-0.1at% Cu Alloy	85.9	90.6	○
42	Ag-0.2at% Sb-0.5at% Cu Alloy	85.2	90.3	○
43	Ag-0.2at% Sb-3at% Cu Alloy	80.9	88.2	○
44	Ag-0.2at% Sb-4at% Cu Alloy	79.2	87.4	✗
45	Ag-0.2at% Sb-0.01at% Au Alloy	86.1	90.7	○
46	Ag-0.2at% Sb-0.1at% Au Alloy	85.9	90.6	○
47	Ag-0.2at% Sb-0.5at% Au Alloy	85.3	90.3	○
48	Ag-0.2at% Sb-3at% Au Alloy	81.4	88.4	○
49	Ag-0.2at% Sb-4at% Au Alloy	79.8	87.6	✗
50	Ag-0.2at% Bi-0.5at% Nd-0.5at% Cu Alloy	84.0	89.8	○
51	Ag-0.2at% Bi-0.5at% Nd-0.5at% Au Alloy	84.0	89.9	○
52	Ag-0.2at% Bi-0.5at% Y-0.5at% Cu Alloy	83.9	89.8	○
53	Ag-0.2at% Bi-0.5at% Y-0.5at% Au Alloy	83.9	89.8	○
54	Ag-0.2at% Sb-0.5at% Nd-0.5at% Cu Alloy	83.9	89.7	○
55	Ag-0.2at% Sb-0.5at% Nd-0.5at% Au Alloy	83.9	89.8	○
56	Ag-0.2at% Sb-0.5at% Y-0.5at% Cu Alloy	83.8	89.7	○
57	Ag-0.2at% Sb-0.5at% Y-0.5at% Au Alloy	83.8	89.7	○
58	Ag-0.2at% Si Alloy	85.5	90.3	○
59	Ag-0.2at% Sn Alloy	85.0	89.9	○

[Table 5]
Results of durability (thermal stability) evaluation

Sample No.	Composition	Change in reflectance before and after high temperature high humidity test [%]		High durability
		Wavelength 405nm	Wavelength 650nm	
1	Pure Ag	-27.3	-3.0	✗
2	Ag-0.005at% Bi Alloy	-1.4	-0.8	○
3	Ag-0.2at% Bi Alloy	-0.7	-0.3	○
4	Ag-0.4at% Bi Alloy	-0.5	-0.2	○
5	Ag-0.6at% Bi Alloy	-0.3	-0.1	○
6	Ag-0.005at% Sb Alloy	-1.6	-0.9	○
7	Ag-0.2at% Sb Alloy	-0.8	-0.4	○
8	Ag-0.4at% Sb Alloy	-0.6	-0.3	○
9	Ag-0.6at% Sb Alloy	-0.4	-0.2	○
10	Ag-0.2at% Bi-0.01at% Nd Alloy	-0.6	-0.2	○
11	Ag-0.2at% Bi-0.1at% Nd Alloy	-0.5	-0.1	○
12	Ag-0.2at% Bi-0.5at% Nd Alloy	-0.3	-0.1	○
13	Ag-0.2at% Bi-2at% Nd Alloy	0.0	0.0	○
14	Ag-0.2at% Bi-3at% Nd Alloy	0.0	0.0	○
15	Ag-0.2at% Bi-0.01at% Y Alloy	-0.6	-0.2	○
16	Ag-0.2at% Bi-0.1at% Y Alloy	-0.5	-0.1	○
17	Ag-0.2at% Bi-0.5at% Y Alloy	-0.4	-0.1	○
18	Ag-0.2at% Bi-2at% Y Alloy	0.0	0.0	○
19	Ag-0.2at% Bi-3at% Y Alloy	0.0	0.0	○
20	Ag-0.2at% Sb-0.01at% Nd Alloy	-0.7	-0.3	○
21	Ag-0.2at% Sb-0.1at% Nd Alloy	-0.6	-0.2	○
22	Ag-0.2at% Sb-0.5at% Nd Alloy	-0.4	-0.2	○
23	Ag-0.2at% Sb-2at% Nd Alloy	0.0	0.0	○
24	Ag-0.2at% Sb-3at% Nd Alloy	0.0	0.0	○
25	Ag-0.2at% Sb-0.01at% Y Alloy	-0.7	-0.3	○
26	Ag-0.2at% Sb-0.1at% Y Alloy	-0.6	-0.2	○
27	Ag-0.2at% Sb-0.5at% Y Alloy	-0.5	-0.2	○
28	Ag-0.2at% Sb-2at% Y Alloy	0.0	0.0	○
29	Ag-0.2at% Sb-3at% Y Alloy	0.0	0.0	○

[Table 6]
Results of durability (thermal stability) evaluation

Sample No.	Composition	Change in reflectance before and after high temperature high humidity test [%]		High durability
		Wavelength 405nm	Wavelength 650nm	
1	Pure Ag	-27.3	-3.0	✗
30	Ag-0.2at% Bi-0.01at% Cu Alloy	-0.6	-0.2	○
31	Ag-0.2at% Bi-0.1at% Cu Alloy	-0.5	-0.1	○
32	Ag-0.2at% Bi-0.5at% Cu Alloy	-0.4	-0.1	○
33	Ag-0.2at% Bi-3at% Cu Alloy	0.0	0.0	○
34	Ag-0.2at% Bi-4at% Cu Alloy	0.0	0.0	○
35	Ag-0.2at% Bi-0.01at% Au Alloy	-0.6	-0.2	○
36	Ag-0.2at% Bi-0.1at% Au Alloy	-0.5	-0.1	○
37	Ag-0.2at% Bi-0.5at% Au Alloy	-0.4	-0.1	○
38	Ag-0.2at% Bi-3at% Au Alloy	0.0	0.0	○
39	Ag-0.2at% Bi-4at% Au Alloy	0.0	0.0	○
40	Ag-0.2at% Sb-0.01at% Cu Alloy	-0.7	-0.3	○
41	Ag-0.2at% Sb-0.1at% Cu Alloy	-0.6	-0.2	○
42	Ag-0.2at% Sb-0.5at% Cu Alloy	-0.4	-0.1	○
43	Ag-0.2at% Sb-2at% Cu Alloy	0.0	0.0	○
44	Ag-0.2at% Sb-4at% Cu Alloy	0.0	0.0	○
45	Ag-0.2at% Sb-0.01at% Au Alloy	-0.7	-0.3	○
46	Ag-0.2at% Sb-0.1at% Au Alloy	-0.5	-0.2	○
47	Ag-0.2at% Sb-0.5at% Au Alloy	-0.3	-0.1	○
48	Ag-0.2at% Sb-3at% Au Alloy	0.0	0.0	○
49	Ag-0.2at% Sb-4at% Au Alloy	0.0	0.0	○
50	Ag-0.2at% Bi-0.5at% Nd-0.5at% Cu Alloy	0.0	0.0	○
51	Ag-0.2at% Bi-0.5at% Nd-0.5at% Au Alloy	0.0	0.0	○
52	Ag-0.2at% Bi-0.5at% Y-0.5at% Cu Alloy	0.0	0.0	○
53	Ag-0.2at% Bi-0.5at% Y-0.5at% Au Alloy	0.0	0.0	○
54	Ag-0.2at% Sb-0.5at% Nd-0.5at% Cu Alloy	0.0	0.0	○
55	Ag-0.2at% Sb-0.5at% Nd-0.5at% Au Alloy	0.0	0.0	○
56	Ag-0.2at% Sb-0.5at% Y-0.5at% Cu Alloy	0.0	0.0	○
57	Ag-0.2at% Sb-0.5at% Y-0.5at% Au Alloy	0.0	0.0	○
58	Ag-0.2at% Si Alloy	-19.9	-2.1	✗
59	Ag-0.2at% Sn Alloy	-18.4	-1.8	✗

[Table 7]

Change in appearance after salt immersion test of Ag-based thin film

Sample No.	Composition	Change in appearance after salt immersion test	High durability
1	Pure Ag	Yes	<input checked="" type="checkbox"/>
2	Ag-0.005at% Bi Alloy	No	<input type="radio"/>
3	Ag-0.2at% Bi Alloy	No	<input type="radio"/>
4	Ag-0.4at% Bi Alloy	No	<input type="radio"/>
5	Ag-0.6at% Bi Alloy	No	<input type="radio"/>
6	Ag-0.005at% Sb Alloy	No	<input type="radio"/>
7	Ag-0.2at% Sb Alloy	No	<input type="radio"/>
8	Ag-0.4at% Sb Alloy	No	<input type="radio"/>
9	Ag-0.6at% Sb Alloy	No	<input type="radio"/>
10	Ag-0.2at% Bi-0.01at% Nd Alloy	No	<input type="radio"/>
11	Ag-0.2at% Bi-0.1at% Nd Alloy	No	<input type="radio"/>
12	Ag-0.2at% Bi-0.5at% Nd Alloy	No	<input type="radio"/>
13	Ag-0.2at% Bi-2at% Nd Alloy	No	<input type="radio"/>
14	Ag-0.2at% Bi-3at% Nd Alloy	No	<input type="radio"/>
15	Ag-0.2at% Bi-0.01at% Y Alloy	No	<input type="radio"/>
16	Ag-0.2at% Bi-0.1at% Y Alloy	No	<input type="radio"/>
17	Ag-0.2at% Bi-0.5at% Y Alloy	No	<input type="radio"/>
18	Ag-0.2at% Bi-2at% Y Alloy	No	<input type="radio"/>
19	Ag-0.2at% Bi-3at% Y Alloy	No	<input type="radio"/>
20	Ag-0.2at% Sb-0.01at% Nd Alloy	No	<input type="radio"/>
21	Ag-0.2at% Sb-0.1at% Nd Alloy	No	<input type="radio"/>
22	Ag-0.2at% Sb-0.5at% Nd Alloy	No	<input type="radio"/>
23	Ag-0.2at% Sb-2at% Nd Alloy	No	<input type="radio"/>
24	Ag-0.2at% Sb-3at% Nd Alloy	No	<input type="radio"/>
25	Ag-0.2at% Sb-0.01at% Y Alloy	No	<input type="radio"/>
26	Ag-0.2at% Sb-0.1at% Y Alloy	No	<input type="radio"/>
27	Ag-0.2at% Sb-0.5at% Y Alloy	No	<input type="radio"/>
28	Ag-0.2at% Sb-2at% Y Alloy	No	<input type="radio"/>
29	Ag-0.2at% Sb-3at% Y Alloy	No	<input type="radio"/>

[Table 8]

Change in appearance after salt immersion test of Ag-based thin film

Sample No.	Composition	Change in appearance after salt immersion test	High durability
1	Pure Ag	Yes	×
30	Ag-0.2at% Bi-0.01at% Cu Alloy	No	○
31	Ag-0.2at% Bi-0.1at% Cu Alloy	No	○
32	Ag-0.2at% Bi-0.5at% Cu Alloy	No	○
33	Ag-0.2at% Bi-3at% Cu Alloy	No	○
34	Ag-0.2at% Bi-4at% Cu Alloy	No	○
35	Ag-0.2at% Bi-0.01at% Au Alloy	No	○
36	Ag-0.2at% Bi-0.1at% Au Alloy	No	○
37	Ag-0.2at% Bi-0.5at% Au Alloy	No	○
38	Ag-0.2at% Bi-3at% Au Alloy	No	○
39	Ag-0.2at% Bi-4at% Au Alloy	No	○
40	Ag-0.2at% Sb-0.01at% Cu Alloy	No	○
41	Ag-0.2at% Sb-0.1at% Cu Alloy	No	○
42	Ag-0.2at% Sb-0.5at% Cu Alloy	No	○
43	Ag-0.2at% Sb-3at% Cu Alloy	No	○
44	Ag-0.2at% Sb-4at% Cu Alloy	No	○
45	Ag-0.2at% Sb-0.01at% Au Alloy	No	○
46	Ag-0.2at% Sb-0.1at% Au Alloy	No	○
47	Ag-0.2at% Sb-0.5at% Au Alloy	No	○
48	Ag-0.2at% Sb-3at% Au Alloy	No	○
49	Ag-0.2at% Sb-4at% Au Alloy	No	○
50	Ag-0.2at% Bi-0.5at% Nd-0.5at% Cu Alloy	No	○
51	Ag-0.2at% Bi-0.5at% Nd-0.5at% Au Alloy	No	○
52	Ag-0.2at% Bi-0.5at% Y-0.5at% Cu Alloy	No	○
53	Ag-0.2at% Bi-0.5at% Y-0.5at% Au Alloy	No	○
54	Ag-0.2at% Sb-0.5at% Nd-0.5at% Cu Alloy	No	○
55	Ag-0.2at% Sb-0.5at% Nd-0.5at% Au Alloy	No	○
56	Ag-0.2at% Sb-0.5at% Y-0.5at% Cu Alloy	No	○
57	Ag-0.2at% Sb-0.5at% Y-0.5at% Au Alloy	No	○
58	Ag-0.2at% Si Alloy	Yes	×
59	Ag-0.2at% Sn Alloy	Yes	×

[Table 9]

Average roughness before and after high temperature high humidity test of Ag-based thin film

Sample No.	Composition	Average roughness before and after high temperature high humidity test [nm]		High durability
		Before test	After test	
1	Pure Ag	4.18	7.33	×
2	Ag-0.005at% Bi Alloy	0.63	0.93	○
3	Ag-0.2at% Bi Alloy	0.58	0.61	○
4	Ag-0.4at% Bi Alloy	0.55	0.58	○
5	Ag-0.6at% Bi Alloy	0.52	0.54	○
6	Ag-0.005at% Sb Alloy	0.65	0.95	○
7	Ag-0.2at% Sb Alloy	0.58	0.63	○
8	Ag-0.4at% Sb Alloy	0.56	0.59	○
9	Ag-0.6at% Sb Alloy	0.54	0.57	○
10	Ag-0.2at% Bi-0.01at% Nd Alloy	0.58	0.60	○
11	Ag-0.2at% Bi-0.1at% Nd Alloy	0.55	0.59	○
12	Ag-0.2at% Bi-0.5at% Nd Alloy	0.52	0.56	○
13	Ag-0.2at% Bi-2at% Nd Alloy	0.45	0.48	○
14	Ag-0.2at% Bi-3at% Nd Alloy	0.44	0.48	○
15	Ag-0.2at% Bi-0.01at% Y Alloy	0.57	0.60	○
16	Ag-0.2at% Bi-0.1at% Y Alloy	0.56	0.59	○
17	Ag-0.2at% Bi-0.5at% Y Alloy	0.53	0.58	○
18	Ag-0.2at% Bi-2at% Y Alloy	0.47	0.53	○
19	Ag-0.2at% Bi-3at% Y Alloy	0.45	0.52	○
20	Ag-0.2at% Sb-0.01at% Nd Alloy	0.58	0.62	○
21	Ag-0.2at% Sb-0.1at% Nd Alloy	0.56	0.60	○
22	Ag-0.2at% Sb-0.5at% Nd Alloy	0.53	0.58	○
23	Ag-0.2at% Sb-2at% Nd Alloy	0.47	0.50	○
24	Ag-0.2at% Sb-3at% Nd Alloy	0.47	0.49	○
25	Ag-0.2at% Sb-0.01at% Y Alloy	0.58	0.63	○
26	Ag-0.2at% Sb-0.1at% Y Alloy	0.55	0.61	○
27	Ag-0.2at% Sb-0.5at% Y Alloy	0.54	0.60	○
28	Ag-0.2at% Sb-2at% Y Alloy	0.46	0.54	○
29	Ag-0.2at% Sb-3at% Y Alloy	0.45	0.53	○

[Table 10]

Average roughness before and after high temperature high humidity test of Ag-based thin film

Sample No.	Composition	Average roughness before and after high temperature high humidity test [nm]		High durability
		Before test	After test	
1	Pure Ag	4.18	7.33	✗
30	Ag-0.2at% Bi-0.01at% Cu Alloy	0.59	0.93	○
31	Ag-0.2at% Bi-0.1at% Cu Alloy	0.58	0.90	○
32	Ag-0.2at% Bi-0.5at% Cu Alloy	0.56	0.86	○
33	Ag-0.2at% Bi-3at% Cu Alloy	0.55	0.75	○
34	Ag-0.2at% Bi-4at% Cu Alloy	0.54	0.73	○
35	Ag-0.2at% Bi-0.01at% Au Alloy	0.59	0.94	○
36	Ag-0.2at% Bi-0.1at% Au Alloy	0.57	0.89	○
37	Ag-0.2at% Bi-0.5at% Au Alloy	0.56	0.84	○
38	Ag-0.2at% Bi-3at% Au Alloy	0.54	0.76	○
39	Ag-0.2at% Bi-4at% Au Alloy	0.53	0.75	○
40	Ag-0.2at% Sb-0.01at% Cu Alloy	0.59	0.95	○
41	Ag-0.2at% Sb-0.1at% Cu Alloy	0.58	0.91	○
42	Ag-0.2at% Sb-0.5at% Cu Alloy	0.57	0.88	○
43	Ag-0.2at% Sb-3at% Cu Alloy	0.56	0.78	○
44	Ag-0.2at% Sb-4at% Cu Alloy	0.54	0.77	○
45	Ag-0.2at% Sb-0.01at% Au Alloy	0.58	0.94	○
46	Ag-0.2at% Sb-0.1at% Au Alloy	0.58	0.90	○
47	Ag-0.2at% Sb-0.5at% Au Alloy	0.57	0.86	○
48	Ag-0.2at% Sb-3at% Au Alloy	0.57	0.79	○
49	Ag-0.2at% Sb-4at% Au Alloy	0.55	0.77	○
50	Ag-0.2at% Bi-0.5at% Nd-0.5at% Cu Alloy	0.50	0.55	○
51	Ag-0.2at% Bi-0.5at% Nd-0.5at% Au Alloy	0.51	0.56	○
52	Ag-0.2at% Bi-0.5at% Y-0.5at% Cu Alloy	0.52	0.57	○
53	Ag-0.2at% Bi-0.5at% Y-0.5at% Au Alloy	0.51	0.55	○
54	Ag-0.2at% Sb-0.5at% Nd-0.5at% Cu Alloy	0.52	0.58	○
55	Ag-0.2at% Sb-0.5at% Nd-0.5at% Au Alloy	0.53	0.60	○
56	Ag-0.2at% Sb-0.5at% Y-0.5at% Cu Alloy	0.52	0.59	○
57	Ag-0.2at% Sb-0.5at% Y-0.5at% Au Alloy	0.54	0.59	○
58	Ag-0.2at% Si Alloy	0.68	1.17	✗
59	Ag-0.2at% Sn Alloy	0.79	1.25	✗

[Table 11]

	Test No.	Composition	Amount of element added (at%)	Evaluation results				
				High temperature high humidity test (Ag aggregation test)		Sheet resistance (Ω/□)		Visible light transmittance (%)
				Before Ag aggregation test	After Ag aggregation test		Discoloration (turning yellow)	Peeling
Comparative Example 1	1	Pure Ag	-	x	12	48	80	x
	2	Pure Ag	0.01	Δ	12	23	80	Δ
	3	Pure Ag	0.04	○	13	16	79	○
	4	Pure Ag	0.12	○	16	16	79	○
	5	Ag-Bi	0.19	○	18	17	78	○
	6	Ag-Bi	1.2	○	20	20	76	○
	7	Ag-Bi	5.1	○	29	30	72	○
	8	Ag-Bi	10.0	○	41	41	43	○
	9	Ag-Sb	0.009	Δ	12	25	80	Δ
	10	Ag-Sb	0.05	○	12	14	78	○
	11	Ag-Sb	0.11	○	13	13	77	○
	12	Ag-Sb	0.22	○	18	17	76	○
	13	Ag-Sb	1.1	○	23	21	73	○
	14	Ag-Sb	4.9	○	31	33	70	○
	15	Ag-Sb	10.0	○	43	45	45	○

[Table 13]

Test No.	Composition	Amount of element added (at%)		Evaluation results			
		Bi/Sb	Others	Sheet resistance (Ω/\square)		After Ag aggregation test	Visible light transmittance (%)
				High temperature high humidity test	Number of white spots generated		
Comparative Example 2	23	Ag	-	98	5	43	79
	24	Ag-Bi	0.19	-	10	16	15
	25	Ag-Bi-Au	0.19	0.3	8	16	16
	26	Ag-Bi-Au	0.19	0.9	5	16	17
	27	Ag-Bi-Cu	0.19	0.4	10	17	20
	28	Ag-Bi-Cu	0.19	1.1	4	17	19
	29	Ag-Bi-Pb	0.19	0.3	8	16	15
	30	Ag-Bi-Pb	0.19	1.5	4	19	19
	31	Ag-Sb-Au	0.21	3.0	0	17	16
	32	Ag-Sb-Au	0.21	10.0	0	26	26
	33	Ag-Sb-Cu	0.21	2.7	0	19	17
	34	Ag-Sb-Cu	0.21	9.7	0	28	30
						48	48

[Table 14]

Test No.	Composition	Amount of element added (at%)	Evaluation results					
			Reflectance (%): Wavelength 400 nm		Surface roughness (nm)		Electric resistance ($\mu\Omega\text{cm}$)	Discoloration (turning yellow)
Example 1	Ag-Bi	Initial reflectance before environmental test [A]	After environmental test [B]	Amount of change [B-A]	Before environmental test [C]	After environmental test [D]		
		1 Pure Ag	-	90.8	63.5	-27.3	7.3	3.1
		2	0.01	89.4	83.0	-5.4	2.1	2.5
		3	0.04	88.2	87.2	-1.0	0.92	0.09
		4	0.19	86.2	85.4	-0.8	0.65	0.71
		5	0.9	81.2	81.4	+0.2	0.64	0.65
		6	2.0	74.3	73.8	-0.5	0.63	0.62
		7	3.1	62.3	62.4	+0.1	0.64	0.66
		8	0.009	89.4	83.0	-5.4	2.1	2.8
		9	0.05	88.2	87.2	-1.0	0.92	1.01
Comparative Example 1	Ag-Sb	10	0.21	86.2	85.4	-0.8	0.65	0.71
		11	1.8	74.3	73.8	-0.5	0.63	0.62
		12	3.0	62.3	62.4	+0.1	0.64	0.66
		13	Ag-Nd	0.4	86.9	85.0	-1.9	0.52
		14	Ag-In	0.40	87.8	83.3	-4.5	3.6
		15	Ag-Nb	0.92	83.8	81.3	-2.5	2.1
		16	Ag-Sn	0.88	85.7	79.0	-6.7	3.5

NOTE: Discoloration (turning yellow): O: No discoloration, Δ : Slight discoloration, \times : Large discoloration

[Table 15]

Test No.	Composition	Amount of element added (at%)	Evaluation results					
			Reflectance (%): Wavelength 400 nm			Surface roughness (nm)		
			Initial reflectance before environmental test [A]	After environmental test [B]	Amount of change [B-A]	Before environmental test [C]	After environmental test [D]	Amount of change [D-C]
1	Pure Ag	-	90.8	63.5	-27.3	4.2	7.3	3.1
4	Ag-Bi	0.19	86.2	85.4	-0.8	0.65	0.71	0.06
17	Ag-Bi-Nd	0.19	0.7	85.1	84.7	-0.4	0.48	0.49
18	Ag-Bi-Y	0.19	0.5	85.4	84.8	-0.6	0.59	0.56
19	Ag-Bi-Cu	0.19	0.9	86.0	85.5	-0.5	0.68	0.70
20	Ag-Bi-Au	0.19	1.0	85.9	85.7	-0.2	0.70	0.71
21	Ag-Bi-Cu	0.19	3.0	87.5	87.2	-0.3	0.63	0.72
22	Ag-Sb-Au	0.20	1.0	86.1	86.0	-0.1	0.65	0.68
23	Ag-Sb-Cu	0.20	1.0	85.8	85.8	0.0	0.64	0.70
24	Ag-Sb-Cu	0.20	3.0	85.1	85.1	0.0	0.59	0.62

[Table 16]

Sample No.	Composition of sputtering target	Bi content of thin film
1	Ag-0.01at% Bi Alloy	<0.001
2	Ag-0.04at% Bi Alloy	<0.001
3	Ag-0.05at% Bi Alloy	0.005
4	Ag-0.20at% Bi Alloy	0.011
5	Ag-1.41at% Bi Alloy	0.056
6	Ag-4.50at% Bi Alloy	0.398
7	Ag-7.00at% Bi Alloy	1.02
8	Ag-14.3at% Bi Alloy	3.82
9	Ag-22.9at% Bi Alloy	9.93
10	Ag-40.8at% Bi Alloy	27.2